

NOTES ON INTRODUCED SLUGS OF THE FAMILIES
LIMACIDAE AND MILACIDAE IN AUSTRALIA,
WITH TWO NEW RECORDS

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SUMMARY

Six species and one variety of milacid and limacid slugs introduced into the Australian fauna are discussed. In the Milacidae these are *Milax gagates* (Draparnaud, 1801) and *M. gagates* var., and in the Limacidae *Deroceras reticulatum* (Müller, 1774), *Deroceras caruanae* (Pollonera, 1891), *Limax maximus* Linnaeus, 1758, *Lehmannia (Lehmannia) nyctelia* (Bourguignat, 1861), and *Lehmannia (Limacus) flava* (Linnaeus, 1758).

Two of these, *D. caruanae* and *L. (L.) nyctelia* are recorded from Australia for the first time.

Keys for the identification of these species are provided and ecological notes given to aid in field studies.

INTRODUCTION

The Australian terrestrial mollusc fauna contains eight families of slugs. Three of these, the Athoracophoridae, the Cystopeltidae and the Rathouisiidae consist of endemic species while the other five are represented only by species introduced to Australia, the Veronicellidae, the Testacellidae, the Arionidae, the Limacidae and the Milacidae. The species of the Veronicellidae were probably introduced from islands of the Southern Pacific while all species of the other four families introduced into Australia originated from Britain or Central Western and Southern Europe and possibly North Africa.

The present study arose out of the need to determine a common limacid slug which did not appear to have been recorded from Australia. Examination of the literature and museum reference collections of introduced slugs in Australia has revealed considerable confusion concerning correct nomenclature and it was felt that a reappraisal of the introduced slug fauna, and in particular the Limacidae and Milacidae, was long overdue. Critical identification of slugs has only been carried out once or twice (Quick 1952, Cotton 1954) and many early mis-identifications have been perpetuated in semi-popular literature.

Introduced slugs were first recorded in Australia by Quoy and Gaimard, 1824, who described two species, *Limax megalodontes* (= *L. flavus*) and *L. maurus* (= *Milax gagates*), from Port Jackson. Several later authors also erected new names for introduced species (Gould, 1852; Selenka, 1865; Lehmann, 1864; Tate, 1881, and Hedley, 1888). An excellent example of the dispersive powers of these introduced species is given by Hedley, 1888, who erected *Limax queenslandicus* as a new species from Burleigh Heads as "The remoteness of the spot in which it was found from the centres of civilization forbids any supposition that it may be an introduced species."

An early assessment of the introduced slug fauna was carried out by Musson (1891) who recorded 5 species of limacids and milacids from many localities in Victoria, New South Wales, Tasmania and Queensland. He recognised as erroneous the many new Australian taxa erected in these families and correctly assigned most of these to existing species. Cotton (1954) repeated this appreciation of the introduced molluscs and added many South Australian localities. This work was reinforced by Quick (1952, 1960) who listed several European species as introductions into Australia. Other species listings were given by Gabriel (1930) for Victoria, and by Petterd and Hedley (1949) and Kershaw (1957) for Tasmania.

The present study attempts to revise the status and composition of the limacid and milacid fauna of Australia, to provide keys to the identification of the species and to add further data concerning the distribution and ecology of the species in Australia. Material verified by dissection is so designated; other material listed has been examined but not necessarily dissected.

KEY TO THE FAMILIES OF AUSTRALIAN TERRESTRIAL SLUGS

1. (a) Body with external shell at posterior end Testacellidae
- (b) Body without external shell 2
2. (a) Body separable into visceral mass and foot at posterior end
 Cystopeltidae
- (b) Body entire 3
3. (a) Body extended on both sides of the foot 4
- (b) Body not extended on both sides of the foot 5
4. (a) Body greatly flattened dorso-ventrally, animal herbivorous
 Veronicellidae
- (b) Body laterally flattened to cylindrical with mid-dorsal keel,
 animal carnivorous Rathouisiidae
5. (a) Body with mantle reduced to small triangle, with respiratory
 orifice mid-dorsally situated, no shell Athoracophoridae
- (b) Body with saddle-shaped mantle, respiratory orifice on right
 side, with internal shell 6
6. (a) Respiratory orifice before the middle of the mantle (Fig. 1a).
 Shell mostly granular Arionidae
- (b) Respiratory orifice behind the middle of the mantle (Fig. 1b)
 shell entire 7
7. (a) Mantle with horseshoe-shaped groove, spermatophore present
 Milacidae
- (b) Mantle without horseshoe-shaped groove, no spermatophore
 present Limacidae

Family MILACIDAE

Mantle with the respiratory orifice behind the middle of the right margin, mantle bears a horseshoe shaped groove. The dorsum is keeled up to the mantle or almost so. A spermatophore is produced.

Introduced Slugs

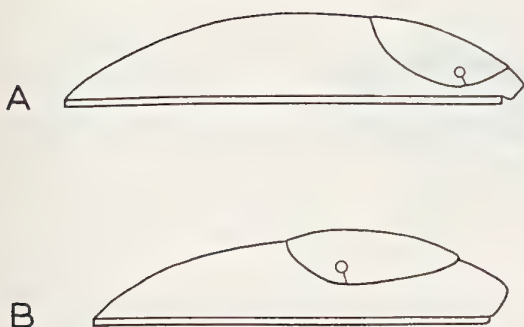


Fig. 1. Two very schematic drawings to show the place of the respiratory orifice; a: *Arion* spec., b: *Deroceras* spec.

Genus *Milax* Gray, 1855

The median area of the sole is crossed by > shaped grooves. The dorsum is keeled up to the mantle. The genus is without lateral body bands at all stages of growth. The shell is thicker than in the *Limacidae* and has a median non-spiral nucleus near the posterior margin. Intestine with one forwardly directed loop (fig. 2b). The pedal gland lies free in the body cavity. The right ocular tentacle lies to the left of both penis and vagina. Atrial glands and a stimulator are present in the Australian species.

The species and a probable variety occurring in Australia can be distinguished as follows:

1. (a) Epiphallus about $2\frac{1}{2}$ times as long as penis
..... *M. gagates* (Draparnaud)
- (b) Epiphallus about 4 times as long as penis and very narrow
..... *M. gagates* (Draparnaud) var?

The species and variety are black or grey in colour, becoming lighter on the sides of the body. The keel is dark and the respiratory orifice is without a pale margin.

It has been postulated that two other species, *Milax sowerbyi* (Férussac, 1823) and *Milax budapestensis* (Hazay, 1881) could occur as introductions in Australia, as both species have been recorded as travellers, the former being tentatively recorded from South America and New Zealand (Quick, 1969). However, so far these species have not been confirmed from Australia and are excluded here until such confirmation is obtained.

Milax gagates (Draparnaud)

Text fig. 2a, b, & c.

- 1801 *Limax gagates* Draparnaud. *Tableau Moll. terr. fluv. France*: 100.
 1824 *Limax maurus* Quoy & Gaimard, *Voy. l'Uranie et la Physic. Zool.*: 427.
 1865 *Limax pectinatus* Selenka, *Malakzool. Bl.* 12: 105.
 1881 *Milax tasmanicus* Tate, *Pap. Proc. R. Soc. Tasm.* for 1880: 16.
 1881 *Milax nigricolus* Tate, *Pap. Proc. R. Soc. Tasm.* for 1880: 17.
 1891 *Amalia gagates*. Musson, *Proc. Linn. Soc. NSW.*, (2) 5: 91.

Length extended about 50 mm. Body black to greyish changing gradually to yellowish-white towards the sole (fig. 2a). Sole pale, divided into three zones, the centre provided with > shaped grooves. Shell

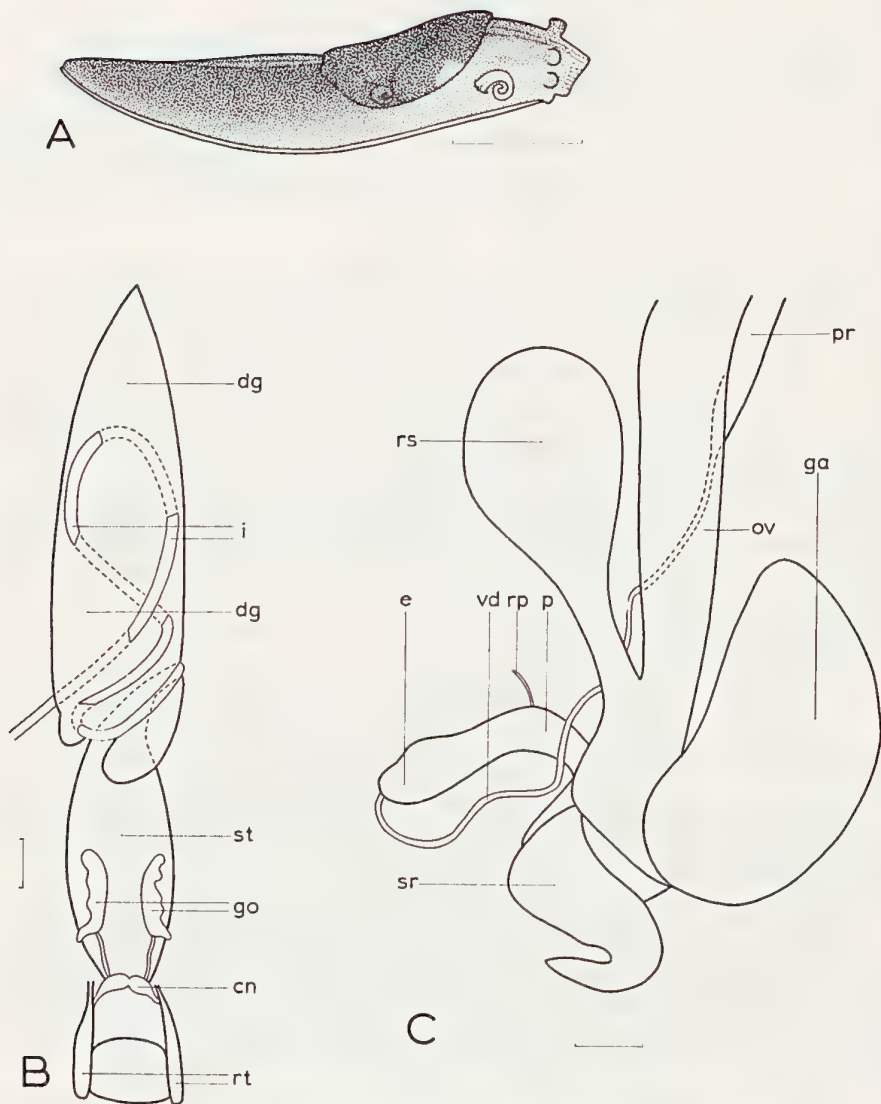


Fig. 2. *Milax gagates* (Draparnaud), Victoria, Doncaster, Donvale High School, 18.viii.1970, ? coll.; a: outer appearance from right side, scale 10 mm; b: alimentary system, scale 2 mm; c: anterior part of reproductive system, scale 1 mm.

about 4.5 x 3 mm, at the top concave from the posterior end, the nucleus is the highest point and lies near the end, flattened at the underside. Radula formula (Quick, 1960) about C 17 27.

The ovotestis is concealed by lobes of the digestive gland. The hermaphrodite duct is folded and the terminal portion is narrow and bears

the talon, which is wider, at its entrance to the albumen gland. From the spermoviduct the female part dominates more and more over the prostate in the development. Where the prostate ends in the vas deferens, the female part changes into the oviduct (fig. 2c). The receptaculum seminis is connected to the oviduct by a short duct which leads to a short vagina. The vas deferens enters the epiphallus which is about two and a half times as long as the penis. The penial retractor inserts where the penis emerges from the epiphallus and the penis and vagina enter the atrium together. The atrial gland, which is about as long as the receptaculum and its duct, also enters in that position. The atrium contains a long, almost smooth stimulator.

The spermatophore is: "a brown chitinous tube about 10 mm long, widest at the centre and narrowing at the anterior end. Except at two places on the concave side, it bears prominent spines throughout. The spines have four main branches, and fourteen or sixteen terminal points". (Quick, 1960).

This transports the sperm from the penis of one partner into the receptaculum seminis of the other where it dissolves (dissolved parts are often found in the receptaculum).

Distribution: S.W. Europe (type-locality: southern France); introduced in North and South America, the Canary Islands, South Africa, Australia, Hawaii.

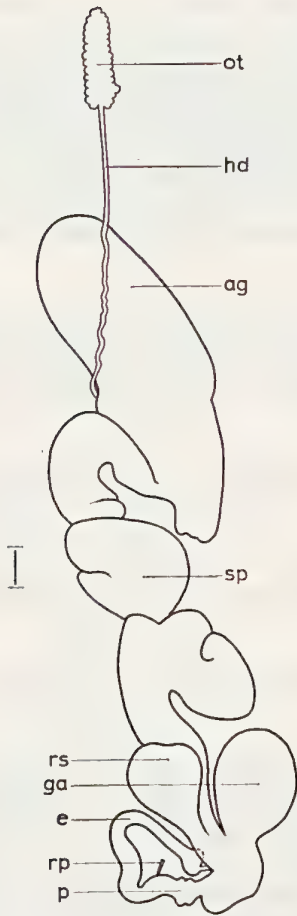
Australian Distribution: Common in southern N.S.W., Vic., Tas., S. Aust., southern W. Aust.

Material examined: Buchan Caves camp ground, Victoria, R. Plant, 6.ix. 1970, 3 spec. (dissected); Doncaster, Victoria, Donvale High School, 18.viii. 1970, 12 spec. (dissected); Jorahomord nr. Orbost, Victoria, B. J. Smith, 1.vi.1967, 1 spec. (dissected); Pyrites Creek, 5 km. E. Bacchus Marsh, Victoria D. Penton, 1.vii.1972, 1 spec. (dissected); plus many undissected specimens collected from throughout Victoria, southern N.S.W., Tasmania and southern Western Australia in the collections of the various state museums.

Remarks: This species is easily recognised in the field by its dark colour and the obvious keel which extends from the tail to the posterior edge of the mantle. The species *Limax maurus* Quoy and Gaimard 1824 from Port Jackson, *Limax pectinatus* Selenka 1865 from Sydney, *Milax tasmanicus* Tate 1881 from Launceston and Hobart, Tasmania and *Milax nigricolus* Tate 1881 from the Adelaide area of South Australia, are here all referred to this species as the descriptions fall within the specific variation of the species. The main reason for the erection of these species from Australian material is the apparent unwillingness of the authors to accept that introduced species could become so widespread and well established in the time from first settlement.

The species is found in areas modified by human settlement or activity such as suburban gardens, cleared land and main access routes into bush areas. Found under logs and stones in damp situations and seen to congregate together in shelter situations in hot dry weather.

Fig. 3. *Milax gagates* (Draparnaud) var.?, Victoria, Pakenham, 4.viii.1970, D. Quincey coll.; reproductive system, scale 1 mm.



Milax gagates (Draparnaud) var.?

Text fig. 3

This variety (?) only differs from *M. gagates* in having the epiphallus much narrower and about four times as long as the penis (fig. 3). We have so far examined 26 specimens of *M. gagates* and 23 of the probable variety, all from Victoria. The variety reminds one somewhat of the South African specimen figured on pl. 2 fig. 13 of Collinge (1900) which he calls *Amalia ponsonbyi* nov. spec. Collinge does not mention how many specimens he saw of this "new species". As *M. gagates* is recorded from both South Africa and Australia, it is probably no more than a variety of this species, but further investigation on living specimens is needed to settle this question.

Family LIMACIDAE

Mantle with the respiratory orifice well behind the middle of the right margin. Keel at the posterior end of the body, not nearly reaching the mantle. The shell is thin and has a nucleus near the posterior right end and growth lines.

KEY TO THE THREE GENERA FOUND IN AUSTRALIA

1. (a) Body spotted or nearly unpatterned, but no bands. The right ocular retractor lies to the left of both penis and vagina. The intestine has one forwardly directed loop (fig. 4b) *Deroceras*
- (b) Body banded or spotted. The right ocular tentacle passes between the penis and the oviduct or vagina. The intestine has two forwardly directed loops (fig. 6b) 2
2. (a) Body mostly banded, sometimes these bands change into spots. No rectal caecum *Limax*
- (b) Body banded or spotted, rectum with a long caecum 3
3. (a) Body without spots and with lateral bands especially on the mantle, receptaculum seminis opens directly into genital atrium *Lehmannia* s. str.
- (b) Body with spots and no lateral bands. Receptaculum seminis opens into oviduct *Lehmannia* (*Limacus*)

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Genus *Deroceras* Rafinesque 1820.

Body spotted or without pattern, but with no bands. The right ocular retractor lies to the left of both the penis and vagina. The penial sarcobelum is present. The intestine has one forward directed loop.

The two species living in Australia can be distinguished as follows:—

1. (a) Large species (\pm 50 mm., fig. 4a), often pale, flaccid body and exudes a white milky mucus when disturbed. Rectum with a caecum *D. reticulatum* (Müller)
- (b) Smaller species, with narrow cylindrical body, no milky secretion. Rectum without caecum *D. caruanae* (Pollonera)

Deroceras laeve (Müller) and *D. agreste* (Linnaeus) have also been quoted as occurring in Australia (Cotton, 1954; Musson, 1891). However, these species have often been confused with the two species confirmed here as occurring in Australia and neither of the species were found in any of the large amount of material examined from many and varied localities. We consider that the records of these two species have been by misidentification in the past and that they should be removed from the Australian faunal list until such times as they are confirmed by critical dissection studies. Both *D. laeve* and *D. agreste* are confined to marsh areas and other damp sites in Britain (Quick, 1961) and while this by no means excludes them from being introduced into Australia, the severity of the dry season in Australia would tend to put extra pressure on to species with such habitat preferences.

Deroceras reticulatum (Müller)

Text fig. 4a, b, c, & d.

1774 *Limax reticulatus* Müller, *Verminum terr. fluv. Historia*, 2: 10.

1891 *Limax agrestis*. Musson, *Proc. Linn. Soc. N.S.W.* (2) 5: 891 (Not Müller).

Length about 50 mm. Yellowish-white with black patches which can vary greatly (fig. 4a), sole yellowish-white. Shell about 4.5 x 3 mm. Radula formula (Quick, 1960): up to C 17 27 and 107 rows.

The ovotestis reaches to or almost to the end of the body cavity. The hermaphrodite duct is twisted with a very narrow portion next to the talon, which is about twice as wide. The spermoviduct is folded; the prostrate terminates in the vas deferens, while the female part terminates in the almost straight oviduct (fig. 4c, d). The most characteristic structure of this species is the penis which consists of two parts (fig. 4c, d). The posterior part bears the appendix which has up to two or three small side-branches; the vas deferens opens into this section and the penial retractor is inserted here. The anterior part contains the sarcobelum, a long triangular shaped structure and with minute longitudinal grooves. The penis, the receptaculum seminis and the oviduct all open into the short atrium.

Distribution: Europe (type-locality: Seeland, Denmark); introduced into most parts of the world with a moderate or subtropical climate.

Australian distribution: Common in southern N.S.W., Vict., Tas., S. Aust., and southern W. Aust.

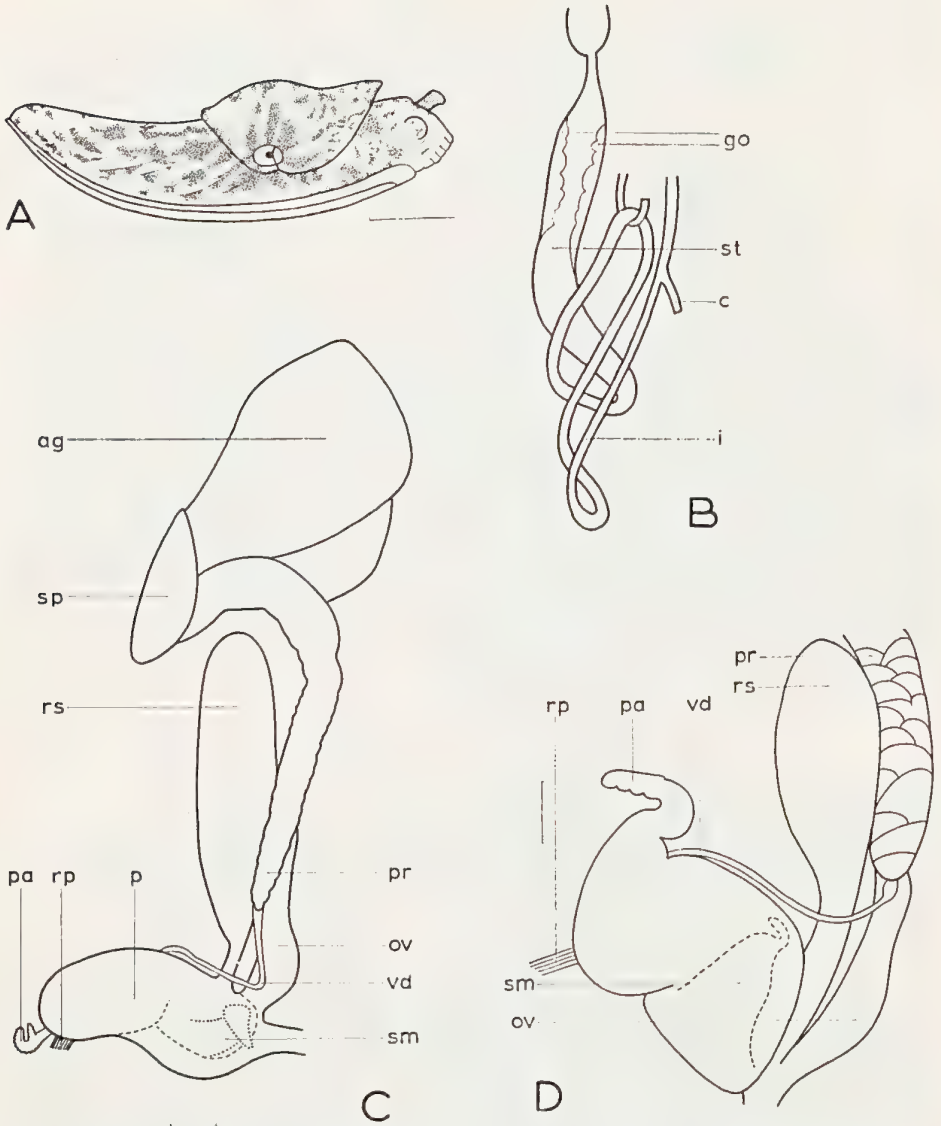


Fig. 4. *Deroceras reticulatum* (Müller), a, d: Victoria, Bairnsdale High School, 1.ix.1967, G. Balaan coll.; b: after Hesse, 1926, pl. 1; c: Victoria, Avoca River, 27.x.1972, B. J. Smith coll.; a: outer appearance from right side, scale 5 mm; b: alimentary system; c: anterior part of reproductive system, scale 1 mm; d: penis, scale 1 mm.

Material examined: Avoca River, Victoria, B. J. Smith, 27.x.1972, 2 spec. (dissected); Bairnsdale High School, Victoria, G. Balaan, 1.ix.1967, 2 spec. (dissected); Eight mile creek, nr. Mitta Mitta River, Victoria, Dartmouth Environmental Survey, 11.iv.1973, 3 spec; Rosedale, Victoria, B. J. Smith and R. J. Plant, 17.vii.1974, 4 spec; Bogong Village, Victoria, A. Marsland, 26.iii.1973, 1 spec. (dissected); Tablelands Road, 11 km. N. of Benambra, Victoria, Dartmouth Environmental Survey, 13.ix.1973,

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2 spec; plus many other specimens collected throughout Victoria, southern N.S.W., Tasmania, South Australia and Western Australia in the collections of the various state museums.

Remarks: The species is recognised in the field by its pale colour with dark brown to grey reticulations, sometimes so dense as to give a dark brown to grey appearance, sometimes with white calcareous looking spots and reticulations. The body often appears swollen and flaccid. the animal slow moving and not very active and a milky white secretion is exuded all over the body when the animal is disturbed.

The records of *A. agrestis* by Musson 1891 are referred to this species as the brief description given appears to fall within the general description of *D. reticulatum*.

The species is common in areas characterised by introduced plants. It is found at the base of stems of pasture grasses and under rocks in damp situations around houses.

Deroceras caruanae (Pollonera)

Text fig. 5a, b, & c.

1891 *Agriolimax caruanae* Pollonera, *Bull. Mus. Torino*, 6 (99) : 3, fig. 2.
(?) 1888 *Limax queenslandicus* Hedley, *Proc. R. Soc. Qld.*, 5 (4) : 150.

Length extended about 30 mm. Yellowish to greyish white with small black spots on the mantle (fig. 5a); sole pale. Shell about 4 x 2.5 mm. Radula formula (Quick, 1960): C 14 55.

The ovotestis lies rather forward and has a short hermaphrodite duct (fig. 5b). The narrow section of the hermaphrodite duct and the talon, which is probably wider, are completely enclosed in the albumen gland.

The spermoviduct is smaller than in *D. reticulatum*. The penis is the main character of this species (fig. 5c) consisting of two parts of which the posterior has two processes between which a tuft of appendices appears. The vas deferens opens here and the penial retractor is attached. The anterior part contains the sarcobelum with minute longitudinal grooves. The penis, the receptaculum seminalis and the twisted oviduct all open into a small atrium.

Distribution: SW Europe (type-locality: Malta); introduced in North America, the Canary Islands, South Africa, Australia.

Australian distribution: Southern Queensland, N.S.W., Vict., Tas., S. Aust., southern W. Aust.

Material examined: Bairnsdale High School, Victoria, G. Balaan, 1.ix.1967, 1 spec. (dissected); Buchan Caves camp ground, Victoria, R. Plant, 6.ix.1970, 1 spec. (dissected); Doncaster, Victoria, Donvale High School, 18.viii.1970, 1 spec. (dissected); Snowy Creek, 5 km. S. of Mitta Mitta, Victoria, L. Winsor, 15.iv.1974, 2 spec.; Mitta Mitta River, 7 km. S. of Hume Weir, Victoria, Dartmouth Environmental Survey, 29.xi.1973, 4 spec.; plus many undissected specimens collected from throughout Victoria, N.S.W., Tasmania, and southern Western Australia in the collections of various state museums.

Remarks: This is the first time that the species *Deroceras caruanae* (Pollonera 1891) has been recorded from the Australian fauna, although

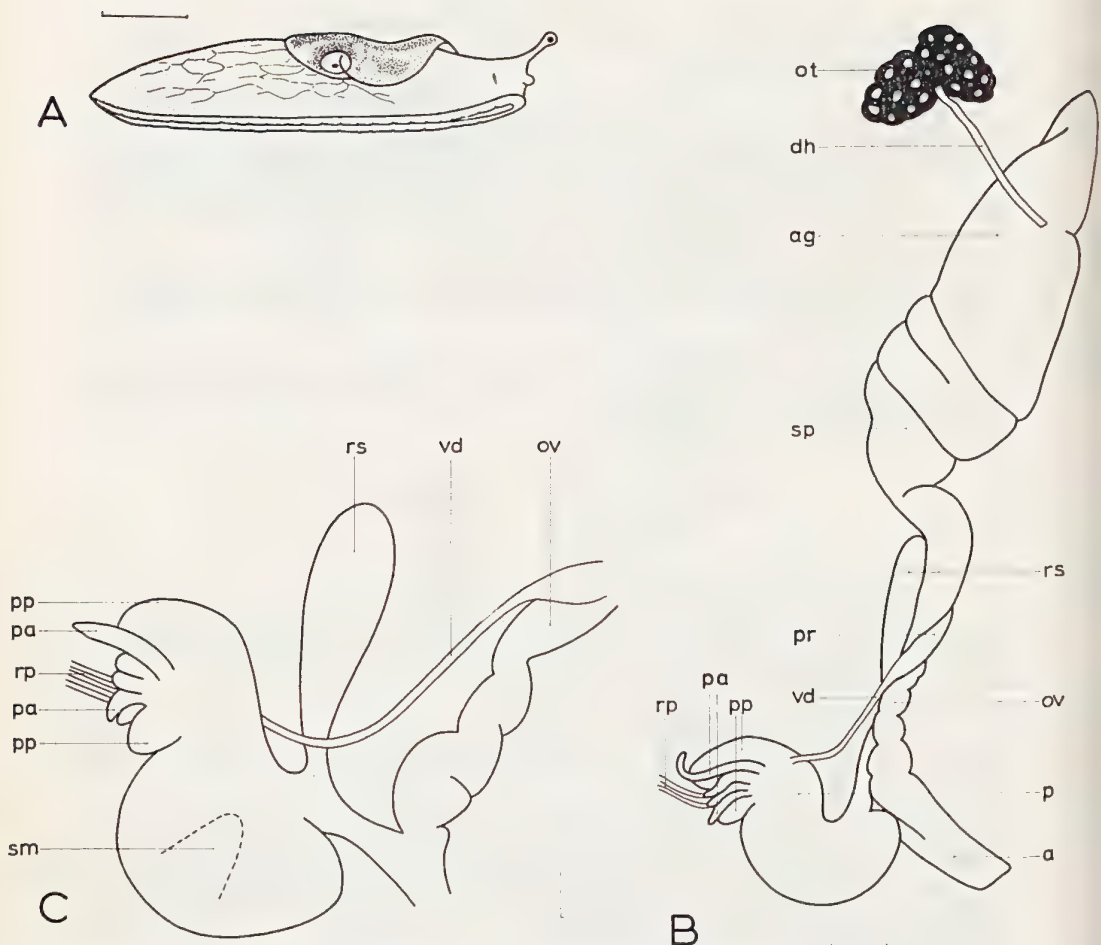


Fig. 5. *Deroceras caruanae* (Pollonera), Victoria, Bairnsdale High School, 1.ix.1967, G. Balaan col.; a: outer appearance from right side, scale 5 mm; b: reproductive system, scale 1 mm; c: anterior part of reproductive system, scale 1 mm.

it is one of the commonest and most wide-spread species of introduced slugs. In the past it has been misidentified as either *D. laeve*, *D. agreste* or even small forms of *D. reticulatum*.

In the field it is distinguished by its small size, light brown to grey uniform colour, cylindrical shape with the head protruding relatively quite a long way forward of the mantle, the non-viscous colourless mucus and the extremely rapid crawling and active behaviour.

Limax queenslandicus Hedley has been very tentatively referred to this species as the description most closely allies it to this taxon. However, a more thorough investigation of this is necessary before any firmer statement can be made. If this relationship is upheld, the unpalatable situation would arise where a name of an introduced species erroneously named as endemic to its host country, could take priority over the accepted name in its native region.

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The species is a firmly established pest both of pasture plants and those of suburban gardens. It is very widespread and can be found in only slightly disturbed native bushland as well as wholly modified habitats. It is a cryptic animal being hard to see because of its size, colouration and its habit of resting in crevices and the root systems of plants.

Genus *Limax* Linnaeus 1758

Limacid with bands on the body, sometimes reducing to spots, principally on the mantle. No long rectal diverticulae.

Limax maximus Linnaeus

Text fig. 6a, b, c, & d.

1758 *Limax maximus* Linnaeus, *Syst. Nat.*, ed 10: 652.

Length extended up to 200 mm. Body yellowish-white; mantle with larger or smaller patches; back mostly with four (fig. 6a) or two bands and frequently with patches, but colour and pattern is very variable with the bands even becoming interrupted and a more or less spotted pattern resulting. Shell 10 x 5 mm in the sub-adult specimen (55 mm length in alcohol) figured here. Shell (Quick, 1960): 11 x 7 mm. Radula formula (Quick, 1960): C 19 50.

In two juvenile specimens from Victoria examined, the ovotestis is situated at the right side of the digestive gland and the backward directed loop of the intestine. Fig. 6d shows the relationship between the penis, vas deferens and tentacle retractor and associated nerves.

Fig. 6c, showing a more developed reproductive system, is based on a specimen from Leiden, Netherlands (length in alcohol, 95 mm), at the male maturity stage, where the ovotestis has attained maximum size and reaches the end of the body cavity. The hermaphrodite duct passes into the albumen gland which is not yet fully developed, while besides this lies the much broader talon. The albumen gland connects with the spermoviduct of which the prostrate is well developed, whereas the female part is not nearly full grown. The female part of the duct leads into the oviduct while the prostate enters the vas deferens which, in turn, leads into the penis near where the retractor inserts. The oviduct is about half the length of the receptaculum seminis and duct. These two structures, together with the penis, lead separately into the short genital atrium.

Distribution: W and Mid-Europe (type locality: Sweden or England); introduced in North America, Australia.

Australian distribution: N.S.W., Vict., Tas., S. Aust.

Material examined: Doncaster, Victoria, 1967, 1 spec.; Pakenham, Victoria, D. Quincey, 4. vii. 1970, 2 spec. (dissected); Mildura, Victoria, A. Borlace, 2. ii. 1971, 3 spec.; Mitta Mitta River, 7 km S. of Hume Weir, Victoria, Dartmouth Environmental Survey Survey, 29. xi. 1973, 3 spec.; plus other material from N.S.W. and Tasmania in other state museums.

Remarks: This is the largest species of terrestrial slug, either native or introduced, found in Australia, reaching 180 mm in length. In the field it is readily identified by its large size, usually bearing dark and light longitudinal bands on the body, though not on the mantle which has irregular dark spotting or marbling. The pattern is usually a clear and

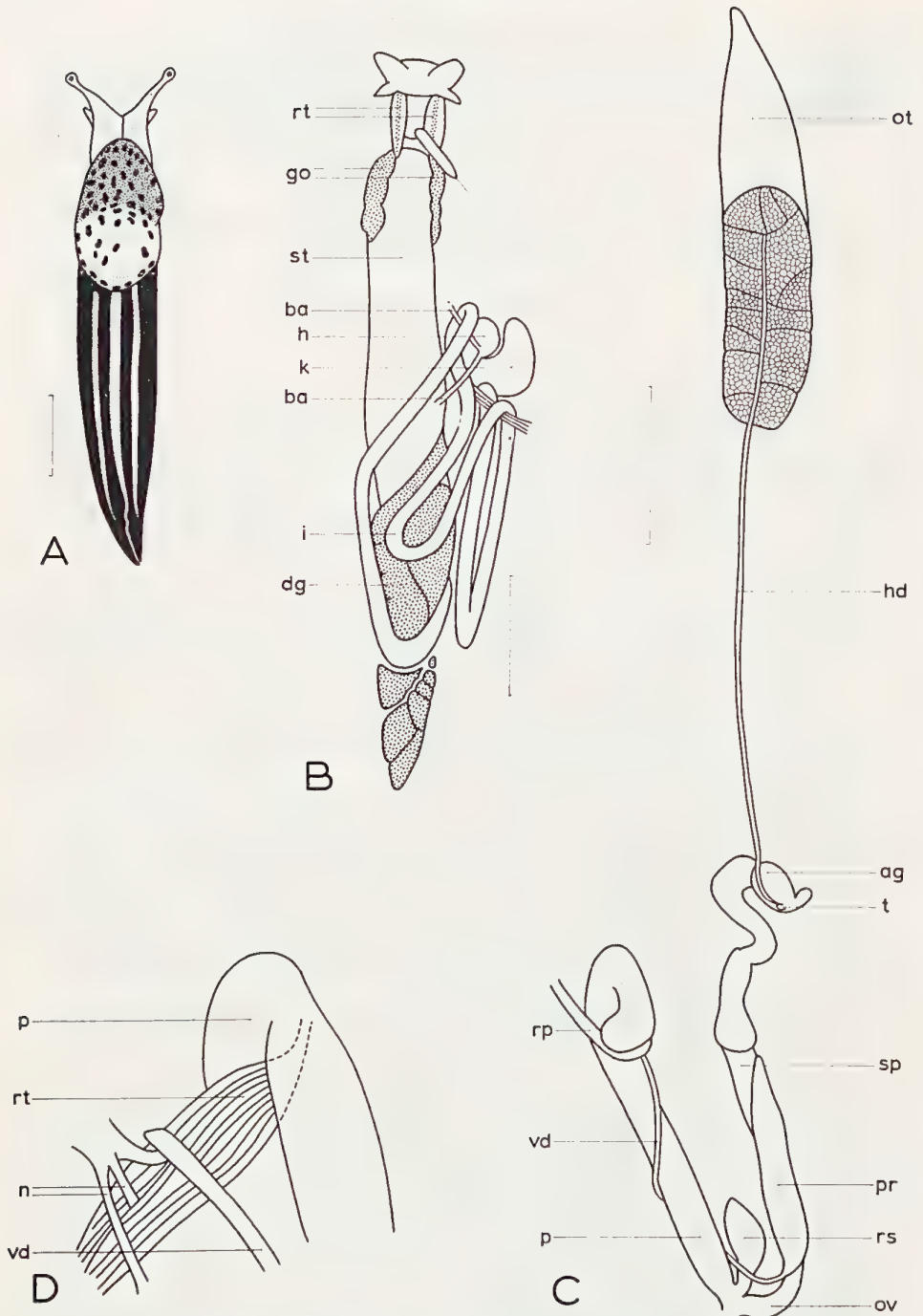


Fig. 6. *Limax maximus* Linnaeus, juv. a, b, d: Victoria, Pakenham, 4.vii.1970. D. Quincey coll. f: *Limax maximus* (male maturity stage), Netherlands, Leiden, 1909, R. Horst coll.; a: cutter appearance from above, scale 10 mm; b: alimentary system, scale 10 mm; c: reproductive system, scale 10 mm; d: anterior side of part of penis and other organs, enlarged.

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distinct one, not blurred into one over-all colour as in the other large slug *Lehmannia (Limacus) flava*. Body and pedal mucus is less viscous than in *L. (L.) flava* and is colourless.

It is not a common species and has a very discontinuous distribution. It is confined to permanently damp localities, usually associated with decaying vegetable matter, but not usually in close association with dwellings. It is found in suburban gardens and in modified open country where its habitat requirements are met. It does not appear to penetrate far into native bush areas.

Genus *Lehmannia* Heynemann 1862

Limacid with bands and spots on the body, with or without lateral bands on the body and mantle. Right ocular retractor passes between the penis and oviduct or vagina. Rectum with a long caecum.

It is proposed to divide the genus *Lehmannia* into two subgenera on the basis of reproductive anatomy. *Lehmannia* s. str. is characterized by the receptaculum seminis opening directly into the short atrium, whereas in the subgenus *Limacus*, the receptaculum opens into the oviduct before it enters the atrium.

The subgenus *Limacus* Lehmann 1864 is intermediate between *Limax* and *Lehmannia*. The radula, with a longer mesocone and a small ectocone on the outermost marginals is similar to *Limax maximus*, whereas *Lehmannia* has a shorter mesocone and more ectocones on these marginals. However, because *Limax cinereoniger* Wolf has a somewhat shorter mesocone and more ectocones on the outermost marginals, we cannot set so much value on the radular characters, at least at generic level. The long intestinal caecum (or diverticulum) is a character of *Lehmannia* (figs. 7b, 8b) and, therefore, we have put the subgenus *Limacus* in this genus.

The two species of this genus found in Australia, one belonging to each of the subgenera, can be distinguished as follows:

1. (a) Body without spots and with lateral bands, especially on the mantle *L. (L.) nyctelia*
- (b) Body with spots and without lateral bands *L. (Limacus) flava*

Subgenus *Lehmannia* s. str.

Description as for genus above with receptaculum seminis opening into a short common genital atrium with the penis and oviduct.

Lehmannia (Lehmannia) nyctelia (Bourguignat)

Text fig. 7a, b, & c.

1861 *Limax nyctelius* Bourguignat, *Spec. malac.*: 41, pl. 2, fig. 3, 4.

1880 *Limax legrandi* Tate, *Pap. Proc. R. Soc. Tas.* for 1880: 16.

Length extended about 50 mm. Brownish on the back with blackish longitudinal bands, especially on the mantle (fig. 7a). On the sides the brownish colour passing into yellowish-white which is also the colour of the tripartite sole. Shell to 5 x 2.75 mm. Radula formula (Quick, 1960, average): C 14 29.

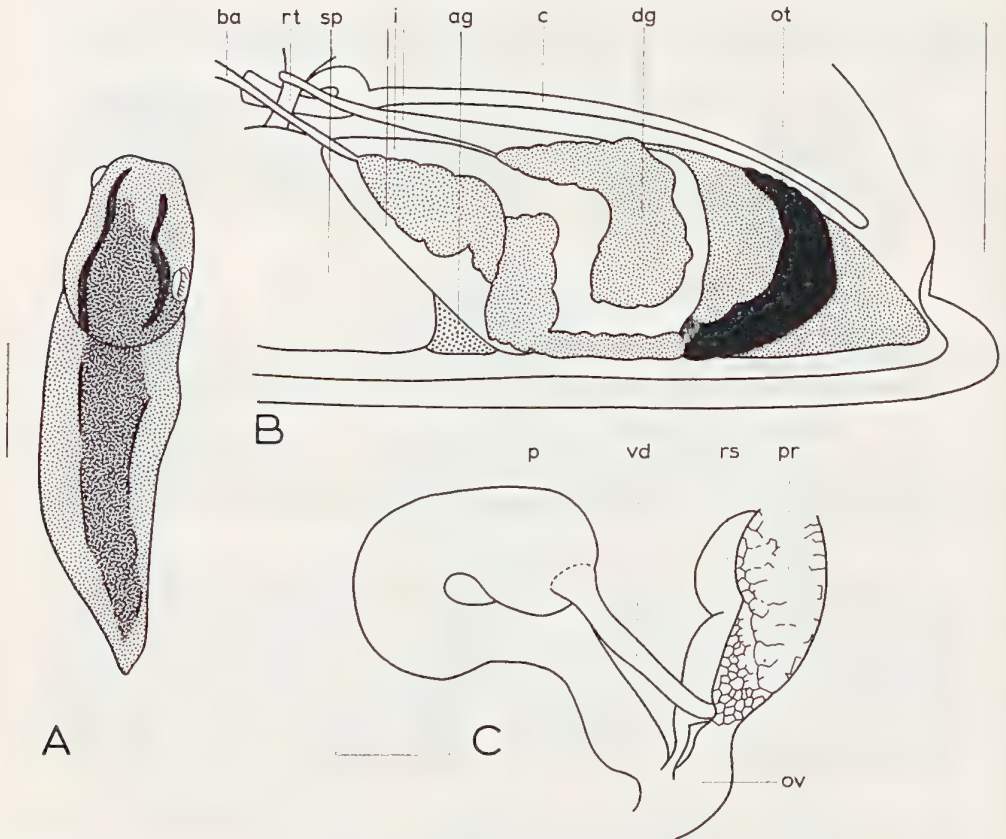


Fig. 7. *Lehmannia (Lehmannia) nyctelia* (Bourguignat), Western Australia, Young River, between Esperance and Ravensthorpe, 22.vii.1968, G. F. Mees coll.; a: outer appearance from above, scale 10 mm; anatomical situation of posterior part, scale 10 mm; c: anterior part of reproductive system, scale 4 mm.

The ovotestis is visible through the body wall and lies near the end of the body cavity (fig. 7b). The hermaphrodite duct is very twisted and leads into and is completely enclosed by the albumen gland. At the posterior end of the spermiduct the female section occupies most of the duct. Anteriorly this is reversed with the prostate enlarging just as it enters the vas deferens (fig. 7c). The short vas deferens enters the long penis at the point of insertion of the penial retractor and the penis, oviduct and the duct of the receptaculum seminis all enter the short atrium separately.

Distribution: North Africa (type-locality: Algeria), western Romania, several localities in Bulgaria, southern Poland; introduced (except perhaps in one locality in West Germany) in North America, South Africa, Australia and greenhouses in Scotland.

Australian distribution: Southern Queensland, N.S.W., and commonly in Vict., Tas., S. Aust. and W. Aust.

Introduced Slugs

Material examined: Melwood, Hillside, Victoria, M. P. Wells, 29. v. 1967, 1 spec. (dissected); Young River between Esperance and Ravens-thorpe, Western Australia, G. F. Mees, 22. vi. 1968, 1 spec. (dissected); Olinda Creek, Dandenong Ranges, Victoria, E. Watkins, 9. i. 1968, 1 spec. (dissected); Cape Otway, Victoria, D. C. Long, 22. v. 1970, 1 spec. (dissected); Bairnsdale State School, Victoria, 1 spec. (dissected); Bendigo, Victoria, J. Plant, 24. v. 1970, 1 spec. (dissected); Ensay, Victoria, J. A. Geeham, 29. v. 1967, 1 spec. (dissected); Launceston, Tasmania, B. J. Smith, 20. iv. 1973, 1 spec. (dissected); plus many other specimens collected throughout Victoria and from various other state museum collections.

Remarks: This is the first record of the species in the Australian fauna, even though it is one of the commoner species of introduced slugs in Australia. The specimens with light body and longitudinal bands on the body and mantle have previously been referred to *Lehmannia marginata* (Muller), but extensive dissection of many specimens from a number of widely separated localities have failed to reveal *L. marginata*, all specimens being referable to this species. We therefore consider that the inclusion of *L. marginata* in the Australian fauna could be an instance of misidentification and propose that it be withdrawn from the Australian list until such times as it is confirmed and accurately located.

Another species which could also be found as an introduction is *Lehmannia valentiana* (Ferussac) and care should be taken in watching for this species when determining *Lehmannia* species.

Lehmannia (L.) nyctelia is easily recognised in the field by its light brown body with two lateral dark stripes on the mantle and body, occasionally with a median stripe also. The body is flaccid and the slug secretes a non-viscous, colourless mucus. The species is very common and widespread, occurring in cleared open country and in modified bush areas. It is found under rocks and logs in litter and around the roots of plants and appears to be well able to survive hot dry weather. It is not usually found in suburban gardens.

Subgenus *Limacus* Lehmann 1864

Description as for the genus above with the receptaculum seminis opening into the oviduct, not into the atrium. Body without lateral bands.

Lehmannia (Limacus) flavus (Linnaeus)

Text fig. 8a, b, & c.

1758 *Limax flavus* Linnaeus, *Syst. Nat.*, ed. 10: p. 652.

1824 *Limax megalodontes* Quoy & Gaimard, *Voy. l'Uranie et la Physic. Zool.*: 428.

1852 *Limax olivaceus* Gould, *U.S. Exp. C. Wilkes. Molls.* 12: 4.

1864 *Limacus brechworthianus* Lehmann, *Malakzool. Bl.*, 11: 145.

1865 *Limax bicolor* Selenka, *Malakotool. Bl.*, 12: 105.

Body extended more than 100 mm. Greyish with yellowish spots on the mantle and back; also yellowish-white sides and tripartite sole; hardly any keel (Fig. 8a). Shell about 9 x 5.5 mm. Radula formula (Quick, 1960): C 20 50 in about 150 rows.

The ovotestis is completely concealed by the lobes of the digestive gland (fig. 8c.). The hermaphrodite duct is extremely twisted and leads to the albumen gland where the end is entirely enclosed. The posterior

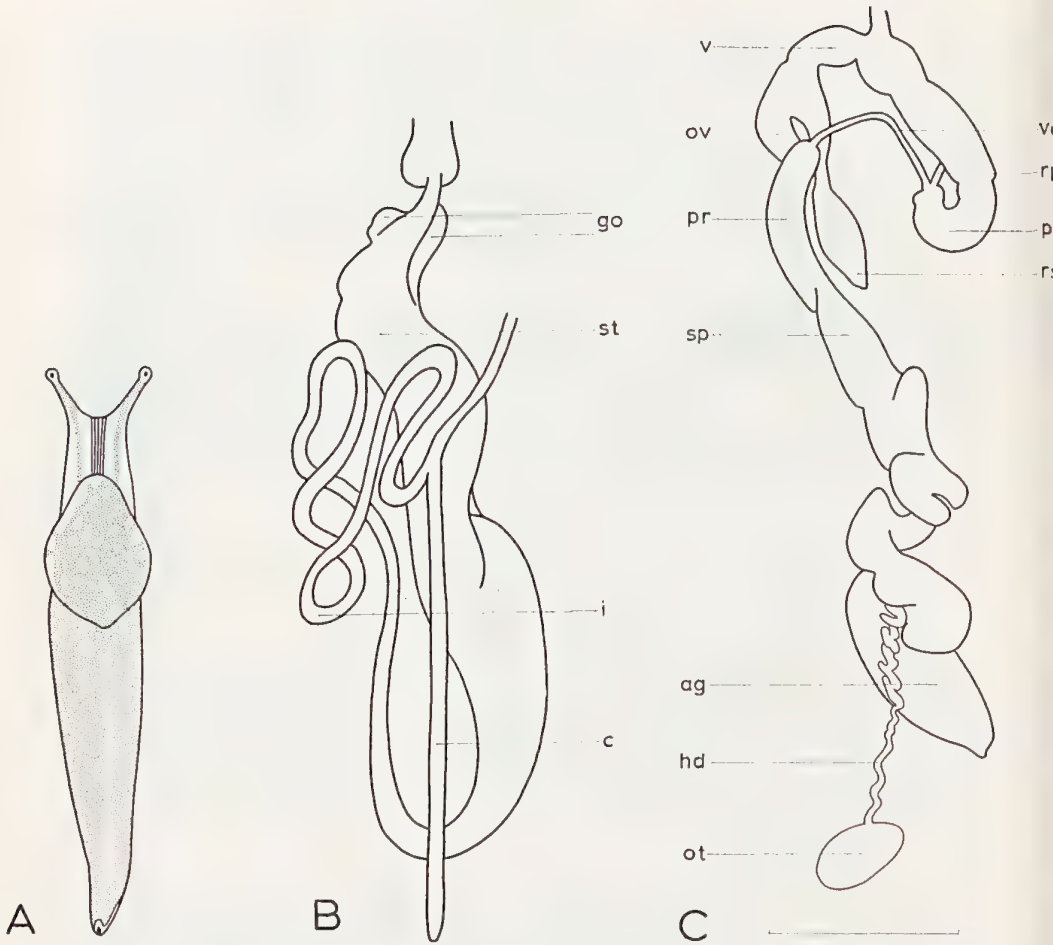


Fig. 8. *Lehmannia (Limacus) flava* (Linnaeus), a, c: Victoria, Mildura, no data; b: after Hesse, 1926, pl. 1 fig. 2; a: outer appearance from above, scale 10 mm; b: alimentary system; c: reproductive system, scale 10 mm

end of the spermoviduct is dominated by female glands, the prostate being more important anteriorly where the vas deferens reemerges. This then leads to the penis joining at the insertion of the penial retractor. The duct of the receptaculum seminis opens into the oviduct and a short vagina and the long penis open into a very short genital atrium. The free anterior end of the prostate gland and the receptaculum seminis opening into the oviduct instead of the atrium are the significant characters of *L. (L.) flava*.

Distribution: Europe and part of Asia (type-locality: Sweden or England); introduced in North and South America, the Canary Islands, South Africa, Australia.

Australian distribution: Southern Queensland, N.S.W., Vict., Tas., South Aust., southern W. Aust. Fairly common, closely associated with human dwellings.

Introduced Slugs

Material examined: Mildura, Victoria, coll.?, date? (dissected); Pascoe Vale, Melbourne, Victoria, B. J. Smith, 23. x. 1969, 1 spec.; Carlton, Melbourne, Victoria, C. Kohlman, Dec. 1974, 1 spec., Moorabbin, Melbourne, Victoria, R. C. Robertson, 16. i. 1970; 1 spec.; plus other specimens from various other state museums.

Remarks: This is a large obvious slug reaching up to 170 mm. in length. It is fairly common in suburban situations close to or in human dwellings where it inhabits damp situations usually associated with decaying vegetation or other material. The four species included here in synonymy were all erected from specimens collected in Australia and thought to be Australian native species. Their descriptions fall within the specific variation of this species and they are tentatively included here. It is of interest to note that one of them, *Limacus breckworthianus* Lehmann 1864 is the original type species of the genus *Limacus* Lehmann 1864.

The species is recognised in the field by its large size, the absence of bands on the mantle, usually a general merging of spots and background colour into an over-all olive-greenish-gray colour and the presence of a viscous yellow-orange mucus secreted all over the body and particularly from the pedal mucus glands.

CONCLUSION

This study establishes the introduced milacid and limacid slug fauna of Australia at six species and one variety, two of which are new records for Australia. It is suggested that several species, which have long been included in the Australian faunal listings, are probably not present, the records being due to misidentification of material. However it is very evident that a great deal more detailed collecting and critical examination of material is required to establish whether any further species should be added to the list. Species most likely to be established as additional introductions to those listed above are as follows:

- | | |
|-----------|-----------------------------|
| Milacidae | <i>Milax sowerbyi</i> |
| | <i>Milax budapestensis</i> |
| Limacidae | <i>Deroceras laeve</i> |
| | <i>Deroceras agreste</i> |
| | <i>Lehmannia marginata</i> |
| | <i>Lehmannia valentiana</i> |

It is hoped that this study will stimulate more interest and work on accumulating basic data on the introduced molluscs, many of which are of major economic importance in Australia.

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Explanations of the abbreviations used in the figures

a:	atrium	ov:	oviduct
ag:	albumen gland	p:	penis
ba:	branch of aorta	pa:	penial appendage
c:	caecum (diverticulum)	pp:	process of penis
cn:	central nervous system	pr:	prostate
dg:	digestive gland	rp:	penis retractor
e:	epiphallus	rs:	receptaculum seminis
ga:	gland of atrium	rt:	tentacle retractor
go:	gland of oesophagus	sm:	sarcobelum (in the penis)
h:	heart	sp:	spermoviduct, female part
hd:	hermaphrodite duct	sr:	stimulator (in the atrium)
i:	intestine	st:	stcmach
k:	kidney	t:	talon (= seminal vesicle, Quick, 1960)
n:	nerve	v:	vag'na
ot:	ovotest's	vd:	vas deferens

All the figures are more or less schematic!